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responding to expiry of the re-transmission time-out timer.

REMARKS

Claims 1-27 are presently in the application.

The Examiner objected to the specification, as there are certain errors on pages 12, line 19, on page13, line 6 and on page 13, line 21.

Applicant has amended the specification, by replacing "receiver 15" on page 12, line 19 with "receiver 17", replacing "routers 19" on page 13, line 6 with "routers 18" and deleting "can not" on page 13, line 21. Applicant has also amended the specification, by replacing "receiver 15" on page 10, line 5 with "receiver 17".

The Applicant submits herewith as a separate appendix A, a version of the amended specification with markings to show the changes made thereto.

Applicant has amended claims 1, 7, 11, 12, 15, 17, 19, 20 and 22 to more clearly define the present invention. Applicant has amended claims 23 and 24, which were dependent on claim 21, to be dependent on claim 22. The amendments to claims are fully supported by the specification as originally filed, especially on page 9, lines 1-4 and page 10, lines 1-3. No new matter has been introduced by way of the present invention.

Applicant has added independent claims 25-27. Claims 25-26 are corresponding to former claims 6 and 18, to which the Examiner indicated that those claims would be allowable if rewritten in independent form. Claim 7 is based on former claims 22 and 24.

The Applicant submits herewith as a separate appendix B, a version of the amended claims with markings to show the changes made thereto.

The Examiner rejected claims 1-2, 4-5, 9-11, 15-16 and 22 under 35 U.S.C. 102(a) as being unpatentable by Sen et al. (U.S. Patent No. 6, 208, 620). As the Examiner provides a quotation of 35 U.S.C. 102(e) regarding this rejection, Applicant submits the reason of why those claims are new and patentable in view of Sen et al.

Sen et al. discloses a wireless access gateway (WAG) 203, which is provided between a mobile station 291 and a Fixed Host 207. The WAG 203 includes a TCP-Aware Agent Sublayer (TAS) 209, a Link Monitoring Agent 211 and a Radio Link Protocol (RLP) 213. The TAS 209 caches TCP packets during forward transmission and acknowledgement ACK of return packets (col. 3, lines 42-58, col. 6, lines 45-53). The gateway 203, which is a transmitter to the mobile station 291 and a receiver to the source, receives an acknowledgement from the mobile station 291 (col. 7, lines 20-22). The Linking Monitoring Agent 211 monitors the air-link frame error rate based on the negative acknowledgement NAK of the RLP (col. 8, lines 53-57, col.9, lines 18-21, claim 2). It is clear that acknowledgements ACKs and negative acknowledgements NAKs are exchanged between the gateway 203 and the mobile station 291, and acknowledgements ACKs are exchanged between the gateway 203 and the source (Figure 2). Further, the Examiner stated that Sen et al. quenches or decreases TCP source window size (col. 6, lines 48-49 and col. 10 lines 60-63). However, as disclosed on col. 9, lines 33-35, Sen et al. quenches TCP transmit window by utilizing the window advertisement field in the acknowledgement message from the TAS 209 to the source. The source of Sen et al. does not quench its TCP window in response to NAKs.

Sen et al. neither discloses nor suggests sending, based on detection of a missing packet, a negative acknowledgement for a missing data packet to a transmitter from a receiver, which is unresponsive to receipt of any other packets from the transmitter, and decreasing, at the transmitter, the size of the congestion window in response to receipt of the negative acknowledgement as recited in claim 1.

It is respectfully submitted that claim 1 and its dependent claims 4-5 and other dependent claims are new and patentable in view of Sen et al.

Regarding to claim 11, the Examiner stated that Sen et al. discloses setting a missing-packet timer for sending NAKs (col. 4, lines 64-65), sending a negative acknowledgement and sending a further negative acknowledgement expiry of the missing-packet timer (col. 5, lines 1-3). Col. 5, lines 1-3 of Sen et al. discloses that if a frame, which a negative acknowledgment (NAK) was sent, is not received correctly before the first timer expires, RLP resets the timer and sends two NAKs for the same frame. Sen et al. does not send a further NAK in addition to a NAK before expiry of the timer. Sen. et al. neither discloses nor suggests that when the missing frame is not received at the receiver in response to the negative acknowledgement, the receiver sends a further acknowledgement before expiry of the missing-packet timer as recited in claim 11. Further, as described above, the system of Sen et al. uses acknowledgements ACKs for packets.

It is respectfully submitted that claim 11 and its dependent claims 12-14 are new and patentable in view of Sen et al.

Regarding to claim 15, the Examiner stated that Sen et al. discloses setting a round-trip timer at the transmitter upon sending the packet (col. 7, lines 54-56), quenching or decreasing the TCP source window (col. 6, lines 48-49, col. 10, lines 60-63) and increasing the round trip delay (congestion window) (col. 8, lines 17-32). As described above, the TCP window size of Sen et al. is not quenched in response to receipt of the negative acknowledgement for the missing packet. Further, col.8, lines 23-29 of Sen et al. discloses that the round trip delay RTD is increased by delaying all ACK packets at the TAS 209. Sen. et al. neither discloses nor suggests increasing the congestion window if no negative acknowledgment for the missing packet is received before expiry of the round-trip timer, and deceasing the size of the congestion window if the negative acknowledgement for the missing packet is received at the transmitter as recited in claim 15. Further, as described above, the system of Sen et al. uses acknowledgements ACKs for packets.

It is respectfully submitted that claim 15 and its dependent claims 16-21 are new and patentable in view of Sen et al.

Regarding to claim 22, the Examiner stated that Sen et al. discloses setting a round-trip timer at the transmitter upon sending the packet (col. 7, lines 54-56), sending from the receiver

NAKs (col. 4, lines 59-64), and quenching or decreasing the TCP source window (col. 6, lines 48-49, col. 10, lines 60-63). As described above, the TCP window size of Sen et al. is not quenched in response to receipt of the negative acknowledgement. As described above, the round trip delay RTD of Sen et al. is not increased in response to receipt of the negative acknowledgement. Further, as described above, the system of Sen et al. uses acknowledgements ACKs for packets.

Sen et al. neither discloses nor suggests a data communications system having a receiver for sending, based on detection of a missing packet, a negative acknowledgement for the missing packet and being unresponsive to receipt of any other packets from the transmitter, a transmitter for setting a round-trip timer, and means for adjusting a congestion window in response to receipt of the negative acknowledgment and expiry of the round-trip timer as recited in claim 22.

It is respectfully submitted that claim 22 and its dependent claims 23-24 are new and patentable in view of Sen et al.

The Examiner rejected claim 3 under 35 U.S.C. 103(a) as being unpatentable over Sen et al. in view of Nakayashiki et al. (U.S. Patent No. 5,912,903).

Nakayashiki et al. discloses a method and system for transferring data. Figure 5 of Nakayashiki et al. discloses a control communication control system (CCS), which is provided between the HOST (corresponding to source end system: SES) 200 and the WS/PC (corresponding to destination end system: DES) 500. As described in Figure 6 and on col. 7, line 60- col. 8, line 9, the CCS sends the acknowledge +Cresp (tx) to the SES each time the CCS receives the given amount of data, and the SES updates the window in receipt of the acknowledgement ACK of the CCS. The Examiner stated that Nakayashiki discloses congestion window is halved (col. 9, lines 45-46). However, the method of Nakayashiki et al. is based on ACKs. Nakayashiki et al neither suggests nor teaches halving the size of the congestion window in response to receipt of the negative acknowledgement as recited in claim 3.

As described above, Sen et al. does not meet the requirements to render claim 1 unpatentable. Claim 3 is dependent on claim 1. Therefore, it is respectfully submitted that claim 3 is patentable over Sen et al. in view of Nakayashiki et al..

The Examiner rejected claims 7 and 20 under 35 U.S.C. 103(a) as being unpatentable over Sen et al. in view of Chuah et al. (U.S. Patent No. 6,400,722).

Chuah et al. discloses a network including end system, which is connected to wireless network using external or internal modems (col. 5, lines 60-62, Figure 2). The Examiner stated that Chuah et al. discloses keep-alive mechanism (keep-alive request) between end systems (col. 23, lines 25-26) and re-transmission flow control services (time-out timer set) (col. 23, lines 29-30). However, col. 23, lines 22-34 of Chuah et al. merely states that keep-alive mechanism, re-transmission and flow control services are provided.

Chuah et al. neither suggests nor teaches periodically sending a keep-alive request from the transmitter to the receiver whereupon a re-transmission time-out timer is set and neither suggests nor teaches that a receiver is responsive to the missing packet and the keep-alive request and is unresponsive to receipt of any other packets from the transmitter as recited in claim 7.

Chuah et al. neither suggests nor teaches sending a keep-alive request from the transmitter to the receiver and setting a re-transmission time-out timer to detect a re-transmission time-out, and neither suggests nor teaches that the receiver is responsive to the missing packet and the keep-alive request and is unresponsive to receipt of any other packets from the transmitter as recited in claim 20.

As described above, Sen et al. does not meet the requirements to render claims 1 and 15 unpatentalbe. Claims 7 and 20 are dependent on claims 1 and 15, respectively. Therefore, it is respectfully submitted that claims 7 and 20 are patentable over Sen et al. in view of Chuah et al..

The Examiner rejected claims 8 and 21 under 35 U.S.C. 103(a) as being unpatentable over Sen et al. in view of Chuah et al. and Jorgensen et al. (U.S. Patent No. 6,452,915).

The Examiner stated that Jorgmsen et al. discloses a loss or time-out of the packet receipt acknowledgment message and "back-off" (col. 17, lines 42-46), which can continue for some time (col. 18, lines 28-31). However, Jorgmsen et al. neither discloses nor suggests that the packet receipt acknowledgment message is an acknowledgement for the keep-alive request.

As described above, Sen et al. does not meet the requirements to render claims 1 and 15 unpatentalbe. Sen et al. and Chuah et al do not meet the requirements to render claims 7 and 20 unpatentalbe. Claims 8 and 21 are dependent on claims 1 and 15 through claims 7 and 20, respectively. Therefore, it is respectfully submitted that claims 8 and 21 are patentable over Sen et al. in view of Chuah et al.. and Jorgensen et al..

Regarding claim 23, the Examiner stated that Sen et al. discloses negative acknowledgement based protocol (col. 4, line 59). However, as described above, Sen et al. uses acknowledgements ACKs for packets. Sen et al. does not meet the requirements to render claim 22 unpatentalbe. Claim 23 is dependent on claim 22. Therefore, it is respectfully submitted that claim 23 is patentable over Sen et al..

The Examiner rejected claims 12 and 14 under 35 U.S.C. 103(a) as being unpatentable over Sen et al. in view of Hamilton et al. (U.S. Patent No. 6,392,993).

The Examiner stated that Hamilton et al. discloses detecting a gap in the packet sequence by the reception of a packet with a non-sequential packet sequence number (on col. 19, lines 57-58). However, col. 19, lines 57-59 of Hamilton et al. discloses that a gap is detected for starting a NAK wait time, and col. 19, lines 59-61 of Hamilton et al. discloses that at the expiration of the NAK wait timer, a NAK is transmitted. Thus, in Hamilton et al., the NAK is not transmitted before expiry of the NAK wait timer. On the other hand, according to claim 11, a further negative acknowledgement is sent before expiry of the missing-packet timer under a certain situation.

Claims 12 and 14 are dependent on claim 11. Thus, the NAK wait timer of Hamilton et al. is different from the missing-packet timer of claims 12 and 14.

Regarding claim 14, the Examiner stated that Hamilton et al. discloses resetting the timer if a packet is received within designated time (on col. 24, lines 32-33). As disclosed on col. 24, line 20 of Hamilton et al., the timer, which is reset, is a timer that determines the lifetime of the message. It is clear that the timer of Hamilton et al. is different from the missing-packet timer of claims 12 and 14.

As described above, Sen et al. does not meet the requirements to render claim 11 unpatentable. Also, Hamilton et al. dose not meet the requirements of render claims 12 and 14 unpatentable. Claims 12 and 14 are dependent on claim 11. Therefore, it is respectfully submitted that claims 12 and 14 are patentable over Sen et al.. in view of Hamilton et al..

The Examiner rejected claim 17 under 35 U.S.C. 103(a) as being unpatentable over Sen et al. in view of Dudley et al. (U.S. Patent No. 5,754,754).

The Examiner stated that Dudley et al. discloses round-trip time update request to receiver (col. 9, lines 22-36). However, Dudley et al. neither suggests nor teaches that the receiver is responsive to the missing packet and the round-up time update request and is unresponsive to receipt of any other packets from the transmitter as recited in claim 17.

As described above, Sen et al. does not meet the requirements to render claim 15 unpatentable. Claim 17 is dependent on claim 15. Therefore, it is respectfully submitted that claim 15 is patentable over Sen et al.. in view of Dudley et al..

The Examiner rejected claim 19 under 35 U.S.C. 103(a) as being unpatentable over Sen et al. in view of Jorgensen et al..

The Examiner stated that Jorgensen et al. discloses increasing continuously transmit window if no packets were lost within last round-trip time (RTT) (col. 45, lines 22-24). However,

Jorgensen et al. merely stated that each TCP source increases its transmit window using the RTT. Jorgensen et al. neither suggests nor teaches multiplicatively increasing the congestion window if no negative acknowledgement for the missing packet is received before expiry of the round-trip timer as recited in claim 19.

As described above, Sen et al. does not meet the requirements to render claim 15 unpatentable. Claim 19 is dependent on claim 15. Therefore, it is respectfully submitted that claim 19 is patentable over Sen et al.. in view of Jorgensen et al..

In view of the above amendments and remarks, and having dealt with all of the matters raised by the Examiner, early reconsideration and allowance of the application is respectfully requested.

Respectfully submitted,

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APPENDIX A – MARKED UP VERSION SHOWING CHANGES TO THE SPECIFICATION

Please amend the specification as shown below.

<u>On pages 9-10, bridging paragraph</u>

– The general operation of system 10 at the transmitter end is shown in the flow chart of Fig. 7, at steps 90, 92, 94, 96, 98, 100, 102, and 104. A communications link between transmitter 15 and receiver 17 is initiated with a conventional 3-way handshake, as described above. Transmitter 15 then determines the round-trip time over network 12. The manner in which these times can be determined is described in greater detail below. A sequence of packets 20 is then sent to receiver ~~15~~ <u>17</u>, and a round-trip timer 3 6 and re-transmission time-out timer 3 8, is set for each packet. When the round-trip timer 36 for each packet expires, the size of the congestion window is adjusted. Generally, in response to receipt of negative acknowledgments at transmitter 15, the transmission rate is decreased. Where no negative acknowledgments are received in a predetermined round-trip time, the transmission rate is increased. If no negative acknowledgments are received during the round-trip time, transmitter 15 assumes packet transmission was successful and increases the congestion window. The transmitter 15 then returns to step 92, where the round-trip time is updated, as necessary, and continues to inject packets into network 12. This process continues until there are no more data packets to transmit, or until a re-transmission time-out occurs, as will be described below. –

<u>On page 12, third paragraph</u>

–In the present invention, the initial round-trip time can be estimated, as in the prior art, during the synchronization phase of the 3-way handshake. However, since the round-trip time can vary over the life of a connection, it is preferable that it be updated during the network session on an ongoing basis. In a presently preferred embodiment, the round-trip time is updated by periodically setting a TCP option on an outgoing data packet requesting a round-trip time update. On detecting this round-trip time update request, receiver ~~15~~ <u>17</u> responds with a forced acknowledgment, a round-trip time update acknowledgment, the purpose of which is to measure the current round-trip time. This permits the use of Van Jacobson's method for calculating the round-trip time.—

<u>on page 13, first paragraph</u>

-- Generally, re-transmission time-outs are required because individual negative acknowledgments may not reach transmitter 15. Negative acknowledgments like all other packets are susceptible to loss in routers ~~19~~ 18, route flapping and physical connection failure. On a re--transmission time-out, transmitter 15 backs off for a predetermined period, ie. it goes into slow-start and sets its congestion window to one. Transmitter 15 then operates in multiplicative increase mode until it hits a threshold value, at which point it reverts to a linear increase for the congestion window. The threshold value can either be threshold value set when transmitter 15 receives three duplicate negative acknowledgments, as described above. Or, if such a threshold value has not been previously set, the threshold value is set, on detection of a re-transmission time-out, as half the value of the current congestion window length. An exponential back-off for re-transmission time-out can also be implemented, as in the prior art. In the presence of successive re-transmission time-outs, the back off duration is doubled for each re-transmission time-out. The re-transmission time-out can be calculated in the same manner as in TCP Reno, or as described below. --

On pages 13-14, bridging paragraph

--Since, in the system of the present invention, negative acknowledgments are only sent when receiver 17 detects problems, no negative acknowledgment over a long period of time can either indicate a serious problem because the negative acknowledgments are not getting through or can indicate that the network is lightly loaded and has not yet encountered a problem serious enough to warrant a negative acknowledgment. Since transmitter 15 cannot ~~can not~~ rely on the presence or absence of negative acknowledgments for re-transmission time-out detection, it can periodically generate keep-alive requests on a much finer granularity than a keep-alive timer in the prior art, which is in the range of one second. Receiver 17 can generate an acknowledgment in response to the keep-alive request. For example, as shown in Fig. 8 at steps 110, 112, 114, 116, and 118, transmitter 15 periodically transmits a keep-alive request, typically piggy-backed on an outgoing data packet, and set re-transmission time-out timer 38. If an acknowledgment for the keep-alive request is returned within the re-transmission time-out interval, the re-transmission time-out timer 38 is cleared, and the process repeats at predetermined periods. If no acknowledgment is received at transmitter 15 within the re-transmission time-out interval, a re-transmission time-out occurs, and transmitter 15 backs off for a predetermined period,

preferably according to the exponential back-off algorithm. On return from back-off, the process repeats. Generally, no packets are re-transmitted unless negative acknowledgments are received from receiver 17, and packet transmission continues with the next scheduled packet. Packets lost in network 12 will be negatively acknowledged when receiver 17 determines which, if any, packets were lost. --

APPENDIX B – MARKED UP VERSION SHOWING CHANGES TO THE SPECIFICATION

Please amend claims 1, 7, 11, 12, 15, 17, 19, 20 and 22-24 as shown below.

1. (Amended) A method ~~for~~ of transmitting data in a data communications network, comprising the steps of:

(i) establishing a communications link between a transmitter and a receiver through a TCP handshake, the communications link having a congestion window set to an initial length;

(ii) transmitting data packets from the transmitter to the receiver;

(iii) detecting a missing packet at the receiver;

(iv) sending a negative acknowledgment from the receiver to the transmitter for the missing data packet, the receiver being unresponsive to receipt of any other packets from the transmitter;

(v) decreasing, at the transmitter, the length of the congestion window in response to receipt of the negative acknowledgment; and

(vi) re-transmitting the missing packet.

7. (Amended) A method according to claim 1, ~~wherein~~ further comprising periodically sending a keep-alive request ~~is periodically sent~~ from the transmitter to the receiver, whereupon a re-transmission time-out timer is set, the receiver being responsive to the missing data packet and the keep-alive request and being unresponsive to receipt of any other packets from the transmitter.

11. (Amended) A method for error recovery in a data communications network where data is transmitted as a sequence of data packets sent from a transmitter to a receiver, a communication link between the transmitter and the receiver being established through a TCP handshake, comprising the steps of:

~~(i)~~ detecting a missing packet at the receiver;

~~(ii)~~ sending a negative acknowledgment from the receiver to the transmitter for the missing packet, the receiver being unresponsive to receipt of any other packets from the transmitter;

~~(iii)~~ setting a missing-packet timer at the receiver upon sending the negative acknowledgment; and

~~(iv)~~ where the missing packet is not received at the receiver in response to the negative acknowledgment before expiry of the missing-packet timer, sending a further negative acknowledgment.

12. (Amended) An error recovery method according to claim 11, wherein the step of detecting a missing packet includes the step of detecting a ~~the~~ missing packet ~~is detected~~ according to a gap in sequence numbers of the stream of data packets, the step of setting a missing-packet timer settings a missing packet timer when the gap is detected.

15. (Amended) A method for congestion control in a data communications network where data is transmitted as a sequence of data packets from a transmitter to a receiver, a communication link between the transmitter and the receiver being established through a TCP handshake, comprising the steps of

~~(i)~~ setting a congestion window to an initial size, the congestion window relating to a transmission rate over the network;

~~(ii)~~ transmitting a data packet from the transmitter to the receiver;

~~(iii)~~ setting a round-trip timer at the transmitter upon sending the packet;

sending a negative acknowledgement for a missing packet from the receiver to the transmitter, the receiver being unresponsive to receipt of any other packets from the transmitter.

~~(iv)~~ increasing the congestion window if no negative acknowledgment for ~~the data~~ the missing packet is received before expiry of the round-trip timer; and

~~(v)~~ decreasing the length of the congestion window if ~~a~~ the negative acknowledgment for ~~the data~~ the missing packet is received at the transmitter.

17. (Amended) A congestion control method according to claim 16, ~~wherein~~ further comprising the step of sending a round-trip time update request ~~is sent~~ to the receiver, the receiver being responsive to the missing packet and the round-up time update request and being unresponsive to receipt of any other packets from the transmitter.

19. (Amended) A congestion control method according to claim 15, whereinthe step of increasing the congestion window includes the step ofmultiplicatively increasing the congestion window if no negative acknowledgement for the missing packet is received before expiry of the round-trip timer ~~the congestion window is multiplicatively increased~~.

20. (Amended) A congestion control method according to claim 15, further including steps of sending a keep-alive request from the transmitter to the receiver, and setting a re-transmission time-out timer to detect a re-transmission time-out, the receiver being responsive to the missing packet and the keep-alive request and being unresponsive to receipt of any other packets from the transmitter.

22. (Amended) A data communications system employing transmission control protocol for providing error recovery and congestion control on a data communications network, comprising:

a transmitter for sending a sequence of data packets, the transmitter having a round- trip timer that is set upon sending each data packet;

a receiver for receiving the sequence of data packets, a communication link between the transmitter and the receiver being established through a TCP handshake, the receiver detecting a missing packet in the sequence of data packets, and returning a negative acknowledgment for the missing data packet to the transmitter to cause re-transmission of the missing data packet, the receiver being responsive to the missing packet and being unresponsive to receipt of any other packets from the transmitter; and

means for adjusting a congestion window in response to receipt of the negative acknowledgment, and expiry of the round-trip timer.

23.(Amended) A system according to claim ~~21~~22, further including a missing-packet timer at the receiver upon expiry of which a final negative acknowledgment is sent to the transmitter.

24. (Amended) A system according to claim ~~21~~22, further including a re-transmission time-out timer at the transmitter, the means for adjusting responding to expiry of the re-transmission time-out timer.

Please add new claims 25-27.

25. (New) A method of transmitting data in a data communications network, comprising the steps of:

establishing a communications link between a transmitter and a receiver, the communications link having a congestion window set to an initial length;

transmitting data packets from the transmitter to the receiver;

setting a round-trip timer at the transmitter upon transmitting the data packet;

detecting a missing packet at the receiver;

sending a negative acknowledgment from the receiver to the transmitter for the missing data packet;

decreasing the length of the congestion window in response to the negative acknowledgment; and

re-transmitting the missing packet; and

increasing the congestion window upon expiry of the return trip timer, the congestion window being doubled.

26. (New) A method for congestion control in a data communications network where data is transmitted as a sequence of data packets from a transmitter to a receiver, comprising the steps of:

setting a congestion window to an initial size, the congestion window relating to a transmission rate over the network;

transmitting a data packet from the transmitter to the receiver;

setting a round-trip timer at the transmitter upon sending the packet;

increasing the congestion window if no negative acknowledgment for the data packet is received before expiry of the round-trip timer; and

decreasing the length of the congestion window if a negative acknowledgment for the data packet is received at the transmitter

wherein the congestion window is doubled, and an interval between transmission of subsequent data packets is decreased, upon expiry of the round-trip timer.

27. (New) A data communications system employing transmission control protocol for providing error recovery and congestion control on a data communications network, comprising:

a transmitter for sending a sequence of data packets, the transmitter having a round- trip timer that is set upon sending each data packet;

a receiver for receiving the sequence of data packets, the receiver detecting a missing packet in the sequence of data packets, and returning a negative acknowledgment for the missing data packet to the transmitter to cause re-transmission of the missing data packet; and

means for adjusting a congestion window in response to receipt of the negative acknowledgment, and expiry of the round-trip timer,

the transmitter including a re-transmission time-out timer, the means for adjusting responding to expiry of the re-transmission time-out timer.